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Vol.		*Vol.*	
I	3 parts, 1928	VI	2 parts, 1933
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THE following were the numbers and year of issue of the *Circular* :—

Vol. 1,	1920, 12 parts	Vol. 4,	1923, 1 part
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As Number 4 of Vol. 3 was printed as " Volume 4 " and Number 1 of Vol. 4 as " Volume 5 " it would appear from an inspection of a complete set that Volume 4 had only a Part 4 and that there were two issues of Volume 5, Part 1.

—EDITOR.

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VOLUME 10, NO. 3, OCTOBER, 1939.

ERRATA.

VOL. 10, No. 2, JUNE, 1939.

Page 49, paragraph 5, line 9.—For " destillates " read distillates.

Page 50, line 8.—Insert " which " between " metal " and " by."

Page 50, 2nd review, paragraph 2, line 2.—For " Crilloo " read Criollo.

Page 52, 2nd article, fifth paragraph.—Insert " was " between " that " and " the ".

Page 53, 2nd review, paragraph 2, line 2.—For " chromosames " read chromo omes.

Page 58, line 1.—Insert " should " between the words " small holders " and " bear."

AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 10.] OCTOBER, 1939. [No. 3.

EDITORIAL.

IT is with regret to our readers, especially country ones, that for the first time in over two years the *Journal* has appeared late. This is due, however, to excessive demands made on the Government Printer in connection with additional printing on account of recent defence activity, coupled with the meeting of Legislative Council. It is hoped that these reasons for the delay in publication will be understood.

In this issue, special attention is directed to the matter of improving local production of food crops. At the end of August, His Excellency the Governor broadcasted a speech in which he pointed out the advisability of paying more attention to this matter as a precautionary measure in the case of emergency. He appealed to all agriculturalists, particularly the small Indian and Fijian farmers, to plant a small area with some of the more rapid growing food crops each month, in order that a succession of food crops would become available through the year. Indications are that the Governor's appeal is being put into practice in most districts of the Colony, but, in addition to food crops, it is suggested that more attention should be paid to the matter of improving the diet by the production of more poultry, pigs and cattle.

In a recent speech in London, the Secretary of State for the Colonies emphasised the fact that the labourers as a whole do not pay sufficient attention to the production of more of their own food requirements and he stressed the need for more variety in the production of food crops in order to raise the general standard of the peasant farmers in the Colonies. In endeavours to settle Fijians on their lands, the Department of Agriculture has consistently stressed the need for the essentials of life, namely, shelter, food and sanitation, rather than the production of money crops, which, while they have their place, should not be regarded as more important than the provision of the essential requirements of the farmer and his family, Developments in the last few years indicate that the Fijians appreciate the wisdom of this policy, since everywhere there is plenty of evidence that the Fijian peasant farmer has an abundance of food crops, adequate housing, and, in most cases, some additional money crops which serves to provide money for his necessary purchases, which are few.

In an interesting paper dealing with Fiji Milk Constants, the Senior Chemist and Laboratory Assistant draw attention to the low values obtained for solids-not-fat in comparison with temperate country standards, and point out that similar results have been recorded in Tanganyika. Fat percentages are very good and the freezing point is a reliable index of adulteration with water. This work was intended to be of service in connection with the Pure Food Ordinance and, therefore, no attempt was made, nor experiment designed, to arrive at an explanation of the results. It is hoped, however, when opportunity permits, to deal with the interpretation of these results in more detailed experiments.

Under Progress Notes on the General Experiment Station located at Sigatoka, a succession of events which led up to the establishment of this station is briefly recorded. The functions of this station are outlined, special mention being made of its function as the main training farm on which student workers will be given a thorough practical training in general agriculture. This educational function is of the utmost importance as a means of training adequately cadets for service in the Department of Agriculture and related Departments, as well as giving students full opportunities for farming their own lands.

The need for such a general experimental station and training farm is apparent, not only for the benefit of Fiji, but it is hoped later for the benefit of the adjacent territories under the jurisdiction of the Western Pacific High Commission so that this station may take the position in agriculture in the Colony that the Central Medical Shool now occupies from the medical standpoint. It is hoped, now that a start has been made, that continuity will be assured, so that the station may become fully efficient as a reservoir of information in all things appertaining to local agriculture.

The importance of rice cultivation in the Colony is indicated in two notes on this crop. In the first, a general survey is given of the rice cultivation situation in the southern part of Tailevu and Rewa, which indicates that there are approximately 1,000 acres under cultivation in this area, and that moderately good crops are harvested annually. The survey shows that the most important variety cultivated is that known as " China Patna." Practically none of the rice grown is of the dry land variety, and the vast majority of the growers are sugar planters as well as rice planters. Besides giving useful information on the rice growing industry in the areas concerned, the survey indicates the potential value of rice experiments which have been carried out for some years by the Department of Agriculture, particularly in connection with the selection and distribution of pure line seed of high yielding, early maturing varieties.

In the second article, rice variety trials at the Central Agricultural Station are briefly summarised. The trials, designed on modern scientific lines, have been carried out over the past three years and indicate that three imported types are definitely of heavier yielding ability than types previously grown in the Colony, including earlier importations. During the current season, it may be mentioned that seed of the three best producing varieties is being distributed on a limited scale to reliable growers with a view to obtaining results on a field scale in the Tailevu and Rewa areas.

Insect pests of stored grain may cause a great deal of damage and various articles and reviews on this subject are well worth attention. An account of the rice leaf-hopper is an interesting example of an insect which has been in the Colony for over 30 years, suddenly becoming a pest and its future position will be closely watched.

As regards the possibility of exporting bananas to the United States of America, it is of interest to note that the ban on this fruit has now been removed. Inaccurate records, some 30 years old, of non-existent fruit flies were material factors operating against the import of bananas from Fiji into America.

In a brief article on green manures, Native Assistant Meli, gives an account of practical methods which can be adopted by all small holders for the utilisation of green manures to their own benefit. He also describes an easy and convenient method of making compost manure, which is not only cheap but very beneficial to all native crops.

During the past year, unusually adverse weather conditions gave ample indication that more attention should be devoted to the shelter of calves from the elements. In this issue, a suitable and economical type of calf-pen is outlined, which should prove of interest and value to all dairy farmers in the Colony. It is evident that the success or failure of a dairy herd depends on the production and rearing of healthy, wellbred, robust calves, and hence it is hoped that full consideration will be given to the article on this subject.

The Chemical Division concerns itself with general chemical work for all Government Departments, for private individuals and firms and with research work approved by the Director of Agriculture. Since such research work is of a long term nature, it is felt that some indication of progress published in the Journal from time to time would be of interest to the general public and so work on sharps- and bread-making from wheat appear in the Chemical Notes.

The new map at the end is purposely drawn at an angle to the margin so as to enable Kadavu to be shown which would have been impossible had it been aligned due north and south.

LOCAL FOOD PRODUCTION.

By
H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture.

On the 29th August, 1939, the *Fiji Times and Herald* published a speech delivered the previous evening over the radio by His Excellency the Governor, dealing with a number of precautionary measures that had been taken in preparation to meet the anticipated needs of the times.

Amongst other matters, in regard to the supplies of essential commodities, His Excellency made the following statement:—

"I now come to the control of necessary commodities, by which I mean not only food-stuffs, but also essentials such as oil, petrol, &c. There has been set up a committee, known as the Necessary Commodities Control Committee, under the chairmanship of Dr. Jack, which has prepared plans—ready to be put into force if the state of emergency should occur—for the control among other matters of imports, exports and local trading operations in essential commodities. Preparations have also been made for the control of the distribution of essential commodities to retailers should our communications be threatened for a period, while a final stage would, in the unlikely event of acute shortage, control the distribution of such commodities to the consumers.

"I want to take this opportunity to appeal directly to all farmers to take immediate steps as a precautionary measure to increase their own production of suitable foods, such as rice, maize, kumalas, tapioca, dalo, beans and other quick-growing crops. I feel sure that agriculturists of all races in the Colony will make a quick and ready response to this appeal, and make this increase in the food resources of the Colony their contribution to national service."

Since the above speech was delivered (in English, Fijian and Hindi) the tragedy of the outbreak of another war has shocked the world, and it has become necessary to take normal precautions to assure that an adequate and regular supply of all essential commodities will be available for all the needs of the Colony.

Through administrative channels, the Government has taken steps to secure the co-operation of the people, more particularly in the matter of increasing the production of locally-grown food crops, so as to render the

Colony more independent of imported food-stuffs, should any interruption of communications with supplying countries occur, though such interruption is, at present, not envisaged.

Through the Director of Education, the schools are being instigated to produce more food crops, and similar steps have been taken through Indian Advisory Committees and other institutions in the Colony, while Agricultural Officers are assisting with advice and seed in their endeavours to induce the small agriculturist to plant a succession of food crops for his own use. The Colonial Sugar Refining Company is also encouraging and assisting cane growers towards this end and agricuturists of all races are urged to plant quick-growing food crops in sufficient quantities to ensure a regular and continuous supply adequate for their families and their immediate dependents. This is best done by each farmer planting a small area, say, from a half to one square chain monthly, with one or preferably more, of the quicker-growing food crops. These include sweet potatoes, maize, tapioca, peanuts, cowpeas, or other beans, cabbage, tomatoes, carrots and other vegetables, and dalo (taro); also yams, bananas and plantains. By this method, a continuous supply of food crops, other than rice, will quickly become available, and the consumption of these crops will enable producers to conserve their rice (stored as padi) for longer periods, and probably over the year until the next harvest.

At the same time, when weather conditions permit, and where suitable lands are available, as much rice as possible should be planted in well-prepared lands and carefully tended so as to produce the best crops possible under existing seasonal conditions. Selected and tested strains of high yielding types of rice will be tried and multiplied on a field scale in certain districts where rice growing is of particular importance with a view to increasing local crop returns and limited stocks of good ordinary seed will be made available at cost price, where necessary. Particular attention should also be given to the avoidance of waste of planting materials, such as dalo tops—all available tops should be planted at once in well-prepared suitable soil—and damaged kumalas and tapioca cuttings. Also, more use might be made of maize meal to add to sharps and flour, with benefit to their nutritive qualities.

These exhortations for co-operation with the Government apply mainly to the Fijians and Indians, but are also intended to embrace Europeans, especially those who have suitable lands for the purpose. Many Europeans on dairy farms and coconut estates can assist in the increase of food-production by ensuring that their labourers are provided with facilities for growing most, if not all, their own root-crops. In fact, a number of these Europeans do already attend to these matters and, in addition, produce much of their own food, but there are many others who could assist much more in this direction and it is expected that they will now do so.

Also, the local food supplies can be materially augmented by producing more poultry, vegetables, pork, &c., for personal use, by withholding the slaughter of bull calves until they are bigger and more mature than is the present custom, and by keeping female pigs until they produce, at least, one or two litters.

There is a tendency to depend too much on imported tinned fish of unsatisfactory nutritive quality as a handy substitute for wholesome fresh fish which should be procurable in much greater quantities, especially by the Fijians, and it is hoped that more attention will be given to this matter in the general effort to lessen the Colony's dependence on imported edible commodities.

In a further speech over the radio on the 4th September, His Excellency the Governor made it known that the Necessary Commodities Control Committee was empowered, should the need arise, to fix the maximum prices of essential requirements, and that Government would not hesitate to do so should any uncalled for profiteering be discovered, but he expressed the opinion that loyal co-operation by the public would render such drastic action unnecessary.

On the 6th September a list of prevailing prices of the more important food commodities commonly in demand, including meats and timber, was published in the local press, as a general guide to prices; it is intended that this list will be revised when necessary and published periodically for the general benefit of all.

Steps are also being taken to complete the volume of imported necessaries, and to assess the production, supplies and normal consumption of the more essential locally-produced commodities, with a view to regularising supplies in adequate volume to meet all requirements and in these matters the ready co-operation of the public has already proved helpful.

The need for more attention to the local production of a greater proportion of our necessary commodities, foods in particular, is evident, and its importance is stressed in the following extract, which appeared in the *Crown Colonist* of August, 1939, from a speech made by the Secretary of State for the Colonies:—

"The labouring population of the Colonies has not given enough time to growing food for consumption in the home market . . . . . That is not a sound policy . . . . . One of the things which we have to do in various Colonies is to make the people somewhat less dependent on the return from export crops. We should encourage them to grow more of their own foodstuffs and to produce more nourishing varieties of local foodstuffs for their own consumption so that they can have fresh vegetables, fresh meat, fresh milk and fresh fruit."

In endeavouring to settle Fijians on their own lands, or on lands secured to them, the Department of Agriculture has consistently insisted on the production of an abundant and varied food-supply as the first essential, so that the settler may be able to provide adequately for all needs of his own family, and there is little doubt that the Fijians appreciate the wisdom of this practice.

In these times, this policy needs amplification and adoption amongst all sections of the community, and it is earnestly hoped that schools, village communities, independent farmers of all races, and managers of labour in industrial and agricultural pursuits, will all show additional practical interest in the increased production of a succession of local food-crops, especially those which can be grown easily and quickly. In addition, efforts should be made to conserve rice supplies (as padi) as much as possible by growing and eating more native root-crops and other vegetables, fresh fish and fresh meat.

Small efforts by many individuals will soon produce a material and cumulative increase in the food resources of the Colony, and this form of national service is of vital importance and lies within the reach of all.

FIJI MILK CONSTANTS.

By

W. J. BLACKIE, M.Sc., F.I.C., F.N.Z.I.C., Mem.Soc.Pub.Anal. (Senior Chemist)

and

G. F. FLEMONS, Laboratory Assistant.

Introduction.—Reference has been made by previous Government Chemists to the low values of solids-not-fat often obtained for unadulterated milk in Fiji. Wright (1) has recorded normal values a little over 8·0 per cent. for the solids-not-fat of milk produced in the Suva area and as a result the Dairy By-laws were passed requiring milk offered for consumption to have a fat content of 3·0 per cent. and a solids-no-fat value of 8·0 per cent. Southall (2) made a series of determinations of milk from local suppliers and his figures indicated a wide variation in the solids-not-fat tending to an average of 8·3 per cent., nevertheless the Pure Food Regulations were passed in 1926 and required that milk conform to a standard of 3·2 per cent. fat and 8·5 per cent. solids-not-fat. Blackie (3) made a series of determinations of solids-not-fat and fat for several cows owned by the Government and pastured on para grass without hand-feeding at Navuso Agricultural Experimental Station. It was found for the beasts concerned that milk could be produced up to the standard demanded by the Pure Food Ordinance. Nevertheless certain samples of genuine milk presented by the Public Health Authorities continued to give low values for solids-not-fat and in order to prevent hardship in the belief that the samples concerned although genuine could not conform with the requirements Blackie (4) introduced the freezing point technique and the Pure Food Regulations were amended to include the Hortvet technique and in conformance with recognised standards abroad, milk was considered to be genuine if it had a freezing point between the limits −0·533°C. and −0·555°C. as determined by the Hortvet technique. It was soon realised that although in the main many of the samples could conform with the solids-not-fat standard several milks contained low solids-not-fat of the order of 8·3 per cent. and even lower and yet had a freezing point within the limits prescribed by law.

Objects of investigation.—In order to determine whether the low value for solids-not-fat was general for herd milk produced under local conditions experiments were arranged with the co-operation of certain dairymen in the Tailevu, Navua and Suva areas of the Colony during the 1938 season. Monthly samples of both morning and evening milk was secured from three herds in Navua, three herds in the Suva and four herds in the Tailevu areas. In the choice of herds attention was given to numbers in the herd and breed of cattle with the object of obtaining as strict a comparison as possible for the areas concerned. It was not possible during the course of this experiment to give attention to individual animals of individuals herd so that the results obtained are affected by all herd variations within the course of a season. Moreover the 1938 season was particularly trying for dairymen owing to the abnormal rainfall experienced generally in Fiji. The rainfall amounted to 158·85 inches at Suva, the average for 50 years being 120·18 inches. It was felt however, that for the experiment concerned data should be obtained for herd milk as supplied for consumption.

During this investigation 240 samples of milk were examined for fat and solids-not-fat and the freezing points were determined on 190 samples. The results obtained are recorded in tables 1 to 4 and are discussed under the headings of fat, solids-not-fat and freezing points.

TABLE 1.—FAT.

(Mean Fat percentages with Standard deviation.)

	Jan.	Feb.	Mar.	April.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	S.D.
Navua, a.m. .	4·23	4·40	4·80	4·33	4·33	4·20	4·36	4·10	4·20	3·80	4·60	4·23	4·29	0·24
Tailevu, a.m. .	3·85	3·75	3·87	4·15	4·15	3·92	3·93	3·80	3·80	3·92	3·75	3·77	3·88	0·13
Suva, a.m. .	4·25	4·15	4·06	4·60	4·15	4·06	3·96	4·33	4·03	3·86	4·00	3·70	4·09	0·22
Navua, p.m. .	4·30	4·40	5·13	4·46	4·46	4·56	4·50	4·40	4·70	4·16	4·53	4·36	4·49	...
Tailevu, p.m.	4·15	4·40	4·43	4·42	4·32	4·45	4·26	4·07	3·95	3·92	4·33	4·30	4·25	...
Suva, p.m. .	4·30	4·90	5·63	5·30	5·60	4·90	5·26	5·43	5·60	4·90	5·16	5·40	5·19	...

Table (1) deals with the mean fat percentages, both morning and afternoon, for the areas concerned and the mean of these means with standard deviation is also included. The figures for fat are extremely good in all areas and with a few exceptions show little variation with season. As has been observed elsewhere, the evening milk gives higher results for fat than the morning milks the figures for the mean values being much higher in the case of Suva and Tailevu. Milk from the Suva area appears to give the better percentage fat yields with Navua a close second and Tailevu slightly lower than Navua. This is reasonably accounted for by a greater proportion of high fat yielders of Jersey strain in the Navua and Suva herds chosen.

TABLE 2.—SOLIDS-NOT-FAT.

(Mean solids-not-fat per centages with standard deviation, S.D.)

	Jan.	Feb.	Mar.	April.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	S.D.
Navua . .	8·56	8·76	8·47	8·75	8·73	8·36	8·63	8·46	8·50	8·57	8·40	8·78	8·58	0·14
Tailevu, a.m. .	8·31	8·26	8·40	8·42	8·42	8·30	8·26	8·27	8·35	8·37	8·52	8·45	8·36	0·03
Suva, a.m. .	8·10	8·55	8·46	8·20	8·25	7·85	8·16	8·16	8·13	8·18	7·90	8·30	8·19	0·21
Navua, p.m. .	8·43	8·68	8·48	8·60	8·60	8·36	8·66	8·26	8·30	8·58	8·20	8·73	8·49	...
Talevu, p.m. .	8·30	8·36	8·23	8·20	8·12	8·20	8·23	8·30	8·12	8·32	8·62	8·40	8·28	...
Suva, p.m. .	8·03	8·42	8·33	8·00	8·00	7·85	7·90	8·00	7·90	8·06	7·76	8·60	8·07	...

In Table (2), values for the solids-not-fat are arranged in a similar manner to the fat values recorded in Table (1). The values for the solids-not-fat are distinctly on the low side. The mean value for Navua milk just satisfies the requirements of the Pure Food Ordinance, although percentages as high as 8·76 are recorded. The mean solids-not-fat values for milk from the Tailevu area are lower than is required under the Pure Food Ordinance; values for the Suva area are distinctly low and well below the requirements of the Pure Food Ordinance. The deviations from the mean for the monthly values are rather significant in the case of Suva milks and point to the operation of disturbing influences which were not elucidated in the course of this investigation. Seasonal and other effects are not so marked with samples from the Navua area and monthly figures for solids-not-fat show little deviation from the mean in the case of the Tailevu samples.

Table (3), records the percentages of solids-not-fat for a Freisian and a Jersey herd from Navua and a Shorthorn herd from Tailevu.

TABLE 3.

(Solids-not-fat percentages with standard deviation.)

	Jan.	Feb.	Mar.	April.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	S.D.
F. Navua ..	8·40	8·40	8·50	8·80	8·8	8·2	8·4	8·20	8·80	8·60	8·00	8·70	8·48	0·25
S. H. Tailevu .	8·60	8·60	8·60	8·70	8·70	8·50	8·30	8·20	8·40	8·40	8·80	8·60	8·56	0·15
J. Navua ..	8·80	8·80	8·32	8·95	8·95	8·40	8·70	8·30	8·10	8·65	8·80	8·90	8·64	0·28

F. = Friesian. S.H. = Shorthorn. J. = Jersey.

The Navua Jersey herd produced on the average solids-not-fat above the requirements of the Pure Food Ordinance and above the composite average for the district (8·64, 8·58). Notable falls occurred in March, August and September. The Shorthorn herd from Tailevu produced fair solids-not-fat of a little lower standard. Again the mean value of 8·56 per cent. is above the composite value for the district and just satisfies requirements. Low figures were obtained in July, August and September. The Friesian herd gave somewhat similar values.

TABLE 4.—FREEZING POINTS.

(Summary of one hundred and ninety freezing point determination.)

Class Interval.	No. in class.	Per cent of total.	Arith. Mean.	Standard deviation.	Maximum.	Minimum.
Below—·520° ..	0	0	....	....	....	....
—·520° to —·525°	2	1·1	....	....	....	—·525°C
—·526° to —·530°	5	2·6	....	....	....	....
—·531° to —·535°	29	15·2	....	....	....	....
—·536° to —·540°	40	21·1	....	....	....	....
—·541° to —·545°	67	35·2	—·543°C	·003°C	....	....
—·546° to —·550°	26	13·7	....	....	....	....
—·551° to —·555°	16	8·5	....	....	....	....
above —·555° ..	5	2·6	....	....	—·592°C	....

Table 4 summarises the data collected from the determination of the freezing points on 190 samples of milk collected in the course of the investigation. The table shows that the average freezing point is —·543°C. (0·002°C.) and that 96 per cent. of the samples examined gave freezing points within the limits prescribed by the regulations. The minimum value, two cases only, is —·525°C. and the maximum —·592°C.

Discussion.—The fat figures call for little comment. It is generally understood that fat percentages are usually higher in the tropics than in temperate regions with similar breeds of cattle. The high figures for Suva p.m. milk call for some comment. This is largely due to the effect imposed on the averages by a rather fine Jersey herd with high percentage fat yield. In general the solids-not-fat are low and are subject to wide variation. The reason for this variation is not well understood but in our opinion it is not directly climatic. Table 3 indicates that well-bred cattle, do not appear to produce solids-not-fat up to temperate standards and that they barely confirm with the Pure Food Regulations in this respect. French and

Raymond (5) have indicated a similar state of affairs in Tanganyika territory and state that a high percentage (over 25) of the grade cows regularly give milk which contains less than the arbitrary legal limit of 8·5 per cent. solids--not-fat. A similar situation is indicated in table (3).

The freezing points are well up to temperate country standards and the average value of —·543°C. as determined by the Hortvet technique is excellent for tropical milks. It is also shown that the freezing point is not closely correlated with the solids-not-fat figure and that the legal limits laid down in the Pure Food Regulations are obeyed by 96 per cent. of the cases. In this connection we consider that the freezing point test is the most valuable of all tests in connection with adulterated milk and although it would not be advisable to reduce the legal value of 8·5 per cent. solids-not-fat, the guiding principle in the matter of adulteration should be the determination of the freezing point.

In conclusion is should be pointed out that soil and pasture conditions vary somewhat in the localities chosen for this investigation. In the Suva area the soils are shallow and deeply eroded and overstocking is noticeably evident. The soils of the Navua area are deep alluvials of the silt loam type. Many of the Navua soils suffer from impeded drainage. The Tailevu soils vary from rich alluvials to good rich rolling hill country (covered with reed under natural conditions) to thin reddish hill soils of a marginal nature. In general, Navua relies on para grass, Tailevu on para and *Mimosa pudica*, and Suva upon the little rough pasturage available together with hand feeding of chop-chop and concentrates. Under unfavourable climatic conditions all areas may require to feed concentrates.

SUMMARY.

1. Under experimental conditions described above it is shown that herd milk from the wet dairy areas of Viti Levu can produce high percentage butter fat.

2. Seasonal variation in butter fat percentage is not marked.

3. Solids-not-fat are on the low side even for tropical milks and compare in this respect with Tanganyika.

4. The deviation from the mean of the solids-not-fat of milk in the Suva area is significant and points to disturbing influences.

5. The freezing points of milk from all areas is up to temperate country standard. The mean figure for 190 samples is —·543°C. and 96 per cent. of the samples conform with the standard laid down in the Amendment to the Pure Food Regulations 1934.

6. It is considered that the freezing point test under Fiji conditions is the most reliable method for detecting adulteration.

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(2) C. L. Southall. Unpublished records Dept., Agric., Fiji.
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EXPORT OF BANANAS INTO THE UNITED STATES.

By

R. J. A. W. LEVER, B.Sc. (Hons.), D.I.C., A.I.C.T.A., F.L.S.

ACCORDING to the notice of Quarantine No. 56, 1936 of the Fruit and Vegetable Quarantine Regulations of the United States, it is forbidden for any bananas to be exported from most foreign localities, including Fiji. The obvious reason for this prohibition is to prevent the introduction into the United States of harmful fruit- and melon-flies, which would soon become pests in the Californian and Floridan citrus orchards. The entry of the dreaded Mediterranean fruit fly into Florida in 1929 shows only too well how real may be the danger and how great the expense of control.

The records of some fruit-flies in Fiji have been shown recently (1) to be erroneous, some insects being not present at all and others not pests of bananas, the data being based on unconfirmed records made over thirty years ago and quoted subsequently without comment. Accordingly, last November, the writer approached the Division of Foreign Plant Quarantine, Washington, D.C. asking if the prohibition might be relaxed in view of the remote danger of fruit-fly introductions on bananas from this Colony. One listed fly, *Strumeta psidii* Frogg., is absent from Fiji and another *S. curvipennis* Frogg is very scarce and not a banana insect.

Through the kindness of the Officer in Charge of the Division previously mentioned, it was found possible to allow the export of bananas from Fiji into the United States, provided that a permit was first applied for. The following notice was accordingly published in the Royal Gazette (2), and is printed in full herewith for the information of any interested party:—

"EXPORT OF FIJI BANANAS TO THE UNITED STATES OF AMERICA.

"It is hereby notified that bananas may provisionally be imported into the United States of America from Fiji under Regulation 2 of the United States Notice of Quarantine No. 56.

"Persons desiring to export bananas to America should make application to the Bureau of Entomology and Plant Quarantine, Washington, D.C., for a permit, stating in the application the country in which the fruit was grown, the port of first arrival, and the name and address of the importer in the United States to whom the permit should be sent.

"Applications for permits should be made in advance of the proposed shipments; but if, through no fault of the importer, a shipment should arrive before a permit is received, the importation will be held in customs custody at the port of first arrival, at the risk and expense of the importer, for a period not exceeding 20 days pending the receipt of the permit.

"Application may be made by telegraph, in which case the information required above must be given.

"A separate permit must be secured for each shipment and for each port of first arrival in the United States.

H. W. JACK,
Director of Agriculture."

This is an example of how records of insects obtained in the most casual way unfairly place restrictions on commercial enterprise, even a generation after they were made. That the final result has been satisfactory is due to the welcome co-operation of the quarantine authorities in America through whose kind offices many people in Fiji may now expect to benefit.

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RICE VARIETY TRIALS AT CENTRAL AGRICULTURAL STATION, 1936-39.

By

B. E. V. PARHAM, M.A.,

Agricultural Officer, South.

For several years past one of the main subsidiary projects undertaken at the Central Agricultural Station, Naduruloulou has been the testing for yield of introduced rice varieties. In addition, quantities of seed padi of the approved varieties " Motka " and " Sonacalif " have been produced for distribution to growers.

The present preliminary article summarizes briefly the results to date of the field experiments designed to obtain reliable information as to the yielding capacity, under local conditions, of certain rice varieties introduced from British Guiana in 1933 and later as well as of the two earlier introductions viz., Borneo E.S. III and Ramay.

The origin of the varieties which form the subject of this study is given below as well as their dates of introduction:—

Variety.	Origin.	Date introduced.	Remarks.
Motka	.....	....	Wet land—widely cultivated.
Ramay	Philippines (1) ..	1931	Wet land (still under trial).
ES—3	Borneo	,,	Still under trial.
B.G. No. 75	British Guinaa (2)	1933	Still under trial (some distributed,
B.G. No. 79	,, ,,	,,	,, ,,
Blue Stick	,, ,,	,,	,, ,,
Demerara Creole ..	,, ,,	,,	,, ,,
Ramcajara	,, ,,	,,	,, ,,

Since 1936 the variety yield trials have been carried out in standardonised plots 484 sq. feet or 1/90 of an acre in area at the suggestion of the Director

Since 1936 the variety yield trials have been carried out in standard randomised plots 484 sq. feet or 1/90 of an acre in area at the suggestion of the Director of Agriculture. Thirty-two randomized plots of eight varieties, each replicated four times have been grown annually with the following results:—

Variety.	Average yield rate per acre to nearest 10 lb.				Mean rate per acre for period 4 years.	
	1936.	1937.	1938.	1939.	lb	cwt.
B.G. No. 75	1800	2200	4410	5550	3490±150	31·2
B.G. No. 79	2290	2110	3510	3800	2930±250	26·2
Demerara Creole	1660	1840	3420	3300	2550±290	22·8
Blue Stick	1370	2290	2420	2580	2160±200	19·4
Ramcajara	1280	1650	2520	2790	2060±240	18·4
Ramay	540*	1890	450*	2270	1289	11·5
Borneo E.S. III	270*	1440	360*	2220	1074	9·6
Motka	130*	1460	1210	1460*	1067	9·5

(* Low yields due to depredations by birds.)

Under the conditions of the trials the yields of all the British Guiana types were heavier than those of Motka, Borneo E.S. III and Ramay. Variations in yield were very high, especially in the first two years, probably due somewhat to the breaking of new land. Judging from the standard deviations indicated in column 6 of the table, B.G. No. 75 is significantly a better yielder than " Ramcajara " and " Blue Stick " and those lower on the list, The first line on the list are early-maturing varieties with a much shorter growth period than the last three—being ready to harvest at from four and a half to five months after planting as against six to six and a half months.

Each year it was noticeable that the plants of the latter varieties were laid by wind and rain before maturity and were much more liable to loss of grain due to birds and rats. Thus in 1937 no grain was harvested from two plots of Borneo E.S. III, and Ramay nor from one plot of Motka.

It is of interest to note that in the rice breeding work in British Guiana the variety Motka from Fiji was discarded in 1934 as being very late maturing (3).

During the period of the trials in Fiji, the varieties B.G. 75, B.G. 79, Blue Stick and Demerara Creole have produced consistently good crops averaging from one ton to one and a half tons of padi per acre.

In padi variety trials carried out in British Guiana, Codd (4) reports that B.G. 79 and Blue Stick gave consistently high yields during the period 1933 to 1936, Demerara Creole being third with relatively poor yields. It is also stated (5) that variety No. 79 proved superior to other standard varieties in British Guiana both in yield and in ability to withstand adverse conditions.

In Fiji the propagation plots of various sizes have given the following results (6, 7, 8):—

Variety.	Yield per acre.			
	1935.	1937.	1938.	1939.
	lb	lb	lb	lb
B.G. 75	1,344	5,060	4,004	2,980
B.G. 79	1,254	4,560	4,312	3,540
Blue Stick	....	2,620	3,256	1,820
Demarara Creole ..	896	3,600	3,520	2,080
Ramcajara	672	3,120	2,904	2,580
Ramay	....	2,907	2,900	....
Borneo E.S. III ..	1,344	....	....	....
Motka	1,400	904	1,981	1,954

These plots varied in area from ·03 to one acre and in most cases were considerably larger than the standardized plots.

The experiments are being continued and it is interesting to record that Indian growers who have received seed of B.G. 75 and B.G. 79 report heavy yields of over one and a half tons to the acre. Some random milling percentages are available: B.G. 79, 73 per cent.; Ramcajara, 65 per cent.; Demerara Creole, 69 per cent.; Blue Stick, 65 per cent.; Sonacalif, 68 per cent.; Motka, 71 per cent.; Ramay, 76 per cent. of clean rice.

The following quantities of pure-line seed have been issued from the Central Agricultural Station to European, Fijian and Indian growers during the past five years:—

Variety.	1932.	1933.	1934.	1935.	1936.	1937.	1938.
	lb	lb	lb	lb	lb	lb	lb
Sonacalif	5,971	2,488	5,481	762	316	588	140
Motka	2,472	3,498	3,000	660	388	271	161
B.G. 79	....	....	....	....	28	....	....
Ramcajara	....	....	....	....	28	132	56
Blue Stick	....	....	....	....	....	28	....
Ramay	....	....	....	....	....	28	....
B.G. 75	....	....	....	....	28	....	56
Totals ..	8,443	5,986	8,481	1,422	788	1,047	413

Distribution of seed was curtailed while experiments were in progress to determine the best type or types for distribution, as indicated by the small quantities quoted for 1936 38. While, owing to the vagaries of the seasons and other factors, the experiments are not conclusive, enough evidence is already available to indicate that the types B.G. 75 and B.G. 79 are well worth multiplication in the vicinity of the Central Agricultural Station and this matter will be given early attention.

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(4) 1936: Codd, L. E. W., Padi Experiments 1933–36, ib. Vol. VII, No. 2, p. 129.
(5) 1936: Codd, L. E. W., Economic Survey of Colonial Empire 1935—p. 351.
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INSECTS IN AIRCRAFT.

In view of the extension of airway service sacross the Pacific Ocean the following review of a letter in *Nature* will be of great interest. Dealing with the proposed alternative air route *via* Africa to India and Australia, Dr. F. G. S. Whitfield draws attention to the danger of the arrival in aeroplanes of insects capable of causing malaria and yellow fever. The areas where yellow fever is endemic are much greater both in Africa and South America than was realized even a year ago and not only can certain mosquitoes transmit the virus (disease producing substance or body) by biting, but monkeys can be orally infected with this disease by simple feeding. The virus also can live over a fortnight inside the body-cavity of at least one species of cockroach. The result of over four years collection of insects found inside aircraft at Khartoum (more than 2,000 machines examined in three years) resulted in 146 species comprising 3,000 individuals including house-flies and the malarial and yellow fever mosquitoes. The writer's conclusion is that until the problem of the insect control in aircraft has been solved it would seem unwise to start a regular service on the route surveyed by the flying boat *Guba*.

—R.J.A.W.L.

Nature, July 22nd, 1939, Vol. 144, No. 3638.

PROGRESS NOTES ON THE GENERAL EXPERIMENTAL STATION, SIGATOKA.

By

H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture.

In 1937, when Sir Frank Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, visited Fiji he reported the need for a central experiment station and indicated that Sigatoka would provide the best location for the purpose.

He intimated that capital expenditure would be required for the acquisition of land, erection of the necessary buildings, the purchase of implements, stock and the provision of an adequate water-supply. He stressed the need for early action and the provision of adequate funds not only for the research needs of the station but in order to provide for the adequate training of the native staff of the Department.

In consequence, a sum of £6,520 was included in the estimates of expenditure for 1938 for the purpose of acquiring the necessary lands and of providing for housing for staff, students and permanent labour; for cattle, horses and small stock; office, laboratory and storage accommodation, garage, workshop, barn and tobacco-curing houses; implements, tools and machinery.

The area selected for the station is situated four and half miles from Sigatoka Government Station on the unfinished road to Naduri. Part of the area has been in use for some years as a Cotton Experiment Station. The area is therefore, easily accessible except that in wet weather the Lawaki creek is sometimes flooded and impassable to motor transport for short periods but it is expected that this drawback will be remedied in the near future.

Unfortunately coincident with this opening of the Queen's Road, land values increased rapidly and greatly exceeded the valuations estimated over two years in advance; also land transactions were very prolonged so that it was not possible to make any headway with any of the required buildings during 1938.

However, during the last few months considerable headway has been made and several buildings are nearing completion, including the bungalows for the resident European Supervisor, the Indian Instructor, the senior Native Assistant, the Indian Field Assistant, the Fijian Clerk; also the barn, the office and laboratory, the garage, the stables and stable lines and the tobacco curing houses. In addition, a water tank has been constructed and work in connection with the water supply is well in hand.

Once again the estimates framed over two years ago proved insufficient in view of the expanded contract rates consequent on the general building activity, so that the building programme has had to be curtailed for the present and the purchase of implements, machinery, additional fencing materials, stock and other items, has had to be postponed pending the availability of further funds.

The total area of the station embraces about 80 acres of arable land and slightly over 200 acres of hilly and undulating land which will in time be planted with permanent crops but on which cultivation will be omitted in the immediate present on the grounds of economy.

The arable land has been divided into three blocks, North, Central and South, each block being further sub-divided into a number of suitable sized plots to permit of economic cultural operations. Also, a nursery area has been demarcated, fenced, drained and brought into condition ready for use.

The public road traverses each of these Divisions and provides a base line from which plot divisions emanate at two chain intervals, the average plot-being approximately five chains in length.

During the second quarter of 1939, the following permanent crops were planted:—Grapefruit, mixed citrus fruits, avocados, cashew nuts, dwarf green, red and yellow coconuts, tall coconuts, tea, rubber, Liberian coffee, bananas, mahogany, teak, "gemene" and candlenuts, while nurseries were established for cocoa, Arabian coffee, tung oil, derris, nutmeg, breadfruit, sisal, &c.

Annual crops include rice, cotton, tobacco, cowpea, Mauritius bean, kumalas, yaqona, tapioca, yams, Irish potatoes, onions, ground nuts, maize, cauliflowers, cabbage, brush millet, various edible beans, lettuce, carrots, pineapples, soya, ginger, taro, various cover crops and various fodder crops.

Considering the adverse weather conditions this year, good progress has been made to date especially as much repair work on roads and fencing and new work on drainage and the levelling of sites for buildings had also to be accomplished. A soil survey was also made as a record on which to base future operations in the treatment of the land.

Much yet remains to be done before the station can be said to be well established—that is, in a condition to perform fully its essential functions.

These comprise a multiplicity of experiments aiming at the best methods to employ in the cultivation of various native and introduced crops; the selection of the best type of crop plants suitable to local conditions; the adoption of the best crop rotations available to the small peasant farmer with a view to the maintenance of fertility and the reduction of labour on his holding; the best practical methods of prevention of soil erosion and the wastage of land; the formation of composts and many other matters which require full investigation on proper scientific lines. As an instance of the value of such work already accomplished this year, mention may be made of rice varietal trials which have just been harvested and in which the five leading popular types of rice were compared as crop yielders in approved Latin square tests resulting in the provision of useful and reliable comparative data. Similarly, selection and varietal experiments are in progress with cotton, tobacco (16 varieties), brush millet, maize, Irish potatoes (15 var.), onions (10 var.), groundnuts and various vegetables.

In addition to variety trials and experiments in rotation cropping, experiments are envisaged in manuring, organic and artificial, in the best cultural treatment for various crops, in pure line selection, in methods of curing and handling crops, in the control of insect, fungoid and other pests, by routine spraying and other practical means. Local information in many of these matters is at present distinctly lacking and presents a wide field for practical and economic research.

Most of the above remarks apply, in the main, to annual crops, but they also apply to permanent crops of which very little reliable knowledge applicable to the small holder is yet available locally.

The station will also function as the main training farm on which student workers will be given a thorough practical course in general agriculture including annual and permanent crops, the use of animals in farming, animal

husbandry embracing horses, cattle, pigs and poultry. Carpentry and blacksmith's work as required by small farmers, elementary accounts, fencing, drainage and all the many essentials which constitute the " stock in trade," of the peasant farmer are all included in the curriculum.

This educational function is of the utmost importance as a means of training adequately candidates for service in the Department of Agriculture and related departments as well as fitting students to make full use of their opportunities in farming their own lands. It is expected that some thirty students will be maintained at the station when it is in condition to receive them—some fifteen or twenty will be in residence by October.

A further function of the station will be to provide pedigree stock for service purposes to farmers resident within a reasonable distance. Towards this end two bulls, three heifers, two stallions, one boar and two flocks of poultry have been obtained and have already proved their utility at other centres.

The station will also serve a useful purpose in providing occular demonstration to the public, and to the small farmer in particular, of the crops which may be grown, the best rotations to follow, the methods employed for the maintenance of crops, pastures and soil fertility, animal husbandry and farming, the harvesting and treatment of crops, the diversity of food crops and many other matters.

The need for such a General Experimental Station and training farm is apparent not only for the benefit of Fiji but it is hoped later, for the benefit of the adjacent territories under the jurisdiction of the High Commissioner for the Western Pacific. Now that a start has been made it is hoped that continuity will be assured in order that the station may become fully efficient as a reservoir of information on all things appertaining to local agriculture.

CALF PENS, (*see Sketch*)

By

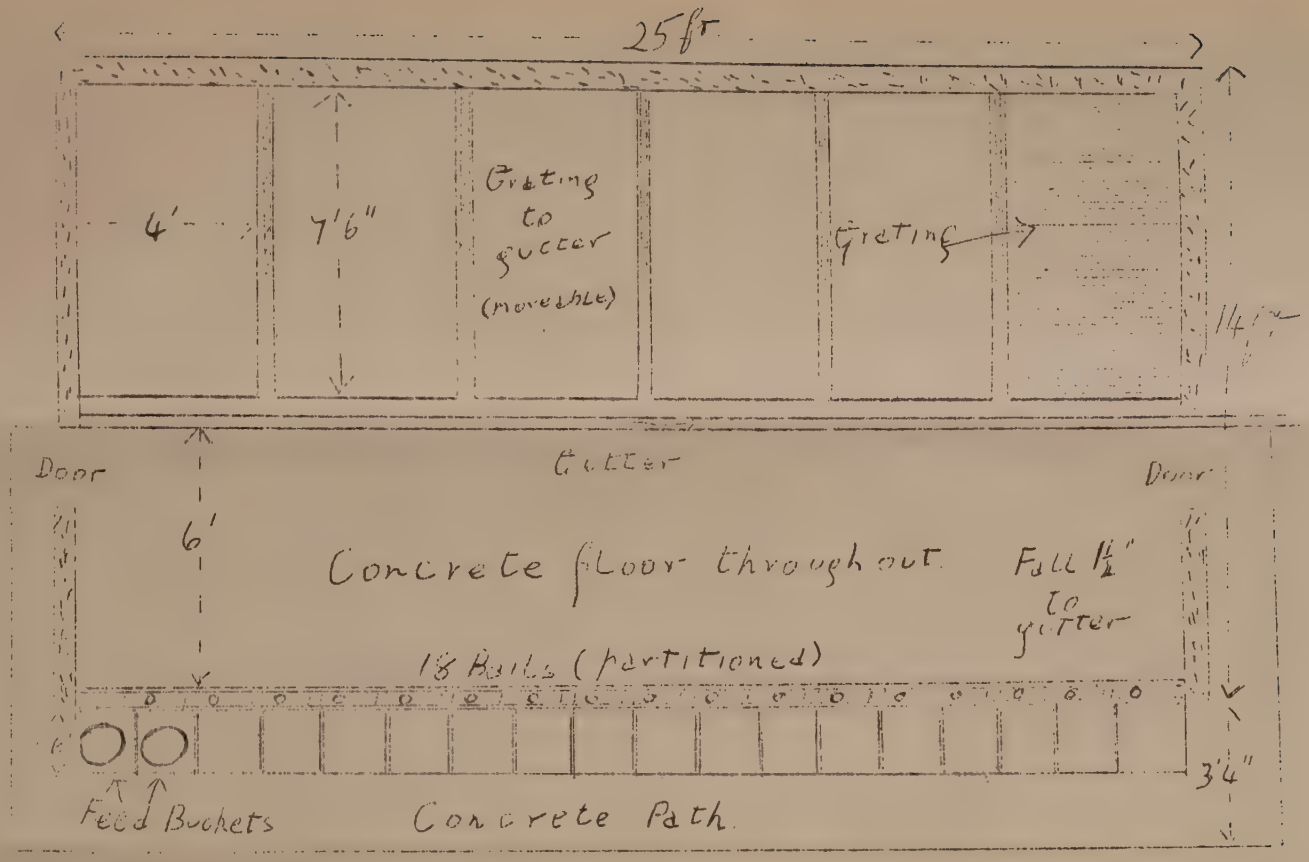
H. T. B. HALL, B.V.Sc.,

Acting Senior Veterinary Officer.

For some time past, dairymen have experienced great difficulty in the rearing of young stock, and in spite of the provision of adequate feed, calves have not developed to the extent that is noticed in other countries. In addition to this lack of development, calves very frequently die during the wet season from nothing more or less than exposure, which is much more likely to affect under-developed, weak, anæmic calves, than those which have progressed in size and resistance as they have become older, and which can withstand the adverse weather conditions of which the past wet season is a fine example.

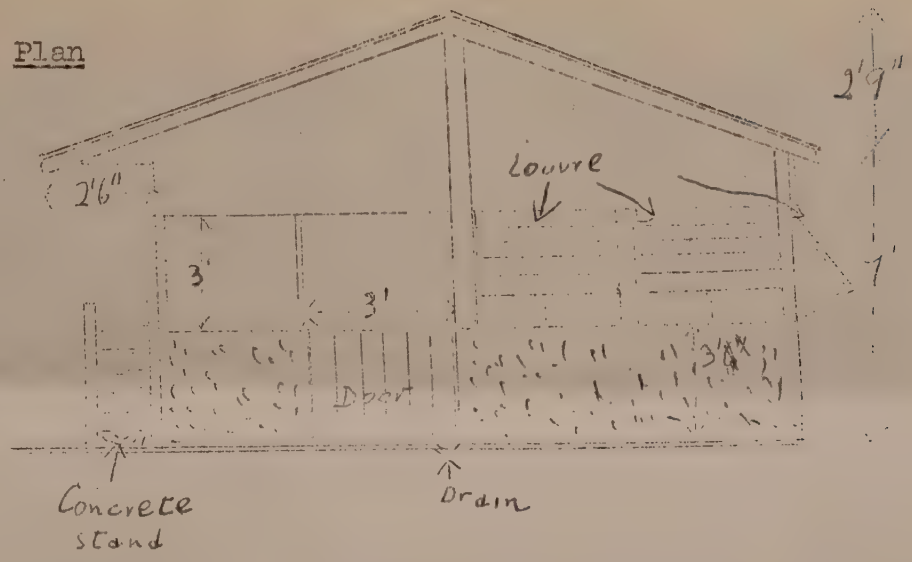
It is clear that, to a marked extent, the success or failure of a dairy herd depends on the production and rearing of healthy well-bred robust calves, which, in due course, are able to take their place in the milking herd with a reasonable chance of becoming a high-producing and economical unit therein and a credit to both the farm and the owner.

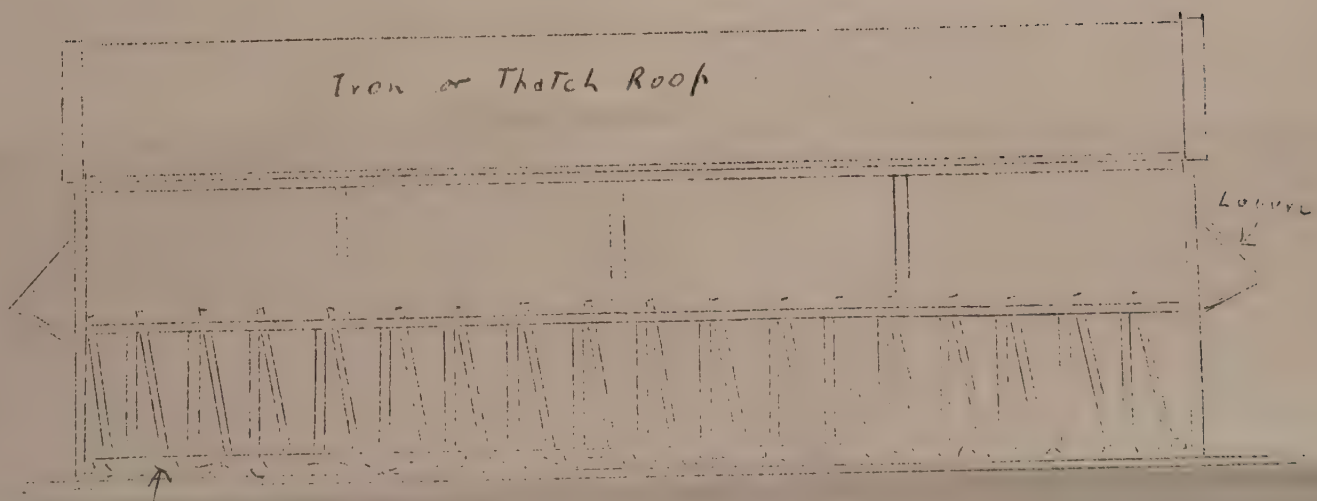
This however, is impossible unless much closer attention is paid to the animal during that most critical of periods, between birth and six months of age. "As much skim milk as they can drink, and calves will look after themselves," has been a principal on which too many have pinned their faith in the past—with consequently disastrous results.



Ground Plan

End view





Front view

One of the main requirements of a calf, and incidentally the one which is most frequently lacking in Fiji, is the provision of adequate shelter. By this is meant a suitable type of calf-pen and shed which will protect them against rain, sun and wind, and at the same time provide them with clean, hygenic, well-ventilated surroundings, free from draughts.

To this end, a suitable design of calf-rearing shed is portrayed in the attached sketch plan, which, even if not erected as described, will offer some useful suggestions for the remodelling of the calves' present quarters.

Throughout the design, economy has not been overlooked, but it must be remembered that money spent on a reasonably permanent structure will soon be made up again in stronger healthier calves. The actual number of bails can, of course, be varied to suit the particular requirements of the individual.

The shed has a concrete floor throughout, which is covered by moveable wooden gratings in the sleeping portion, the gratings being 2 in. by 3 in. spaced 1 inch apart and extending 7½ feet from the back wall. This is divided into six separate pens by concrete partitions three feet high, four inches thick and extending four feet forward from the back wall. The back and end walls are also of concrete, four inches thick and three feet high from the floor level. There should be a fall of 1½ inches from the front and back to the central gutter.

The eighteen feeding bails along the open front are separated by wooden partitions and there is a concrete base on which to stand the feed buckets. This base is 6 inches high and 17 inches wide, and runs the full length of of the house.

The roof is of corrugated iron or asbestos or of thatch. Asbestos has the advantage of ensuring a more even temperature, but is 15 per cent. more expensive than iron. The upper portion of the end walls is boarded in. A space of 6 inches should be allowed in the top of the back wall, under the roof, for ventilation, the remaining 6 inches being boarded in.

Ventilating push out louvres cover a space 3 feet high, and extend all along the back, and the sides as far as the door.

Calves up to one week or so old can be given individual attention, and can be kept separate from the main herd by a temporary partition stretching from one of the end cubicle walls of the inside portion to the bails at the front.

The use of concrete flooring throughout is particularly important, not only for facilitating the cleaning of the pen, but also in preventing diseases. Such diseases as white scours, blood scours, calf pneumonia, joint ill, navel ill, &c., are very soldom seen when calves are kept under hygienic conditions, and hence the first step which the dairymen should take is the provision of a suitable calf-pen.

RICE CULTIVATION IN TAILEVU SOUTH AND REWA.

By

B. E. V. PARHAM, M.A., Agricultural Officer South.

and

B. RAMNATH, Indian Assistant.

A SUMMARY of rice plantings by Indian farmers was undertaken during June, 1939, in the nine districts of Tailevu South and the five districts of Rewa which form the south-eastern portion of the Southern Agricultural Division. The results were as follows:—

TAILEVU SOUTH.

Variety.	No. of growers.	Area planted.	Average area per grower.
		Acres.	Acres.
1. China Patna ..	405	710·8	1·75
2. Motka	46	81·8	1·78
3. Serea Patna ..	50	74·5	1·49
4. Rewa Patna ..	28	41·4	1·48
5. Chetwa	13	9·8	0·75
6. Karia Patna ..	6	4·3	0·72
7. Basmatia ..	5	3·2	0·64
8. Ramcajara ..	2	1·8	0·9
9. Makhanchun ..	1	1·2	1·2
10. Sahibddhna ..	1	1·3	1·3
11. Motmuria ..	1	·3	0·3
Total ..	558	930·4	average 1·7

REWA DISTRICTS.

Variety.	No. of growers.	Area planted.	Average area per grower.
		Acres.	Acres.
1. China Patna ..	32	26·2	0·82
2. Motka	8	7·6	0·95
3. Serea Patna ..	4	4·3	1·075
4. Chetwa	4	2·2	0·55
5. Rewa Patna ..	1	·8	...
6. Karia Patna ..	1	·5	...
Total ..	50	41·6	average 0·8

As will be seen, the average area of rice grown was 1·7 acre in Tailevu and 0·8 acre in Rewa; the maximum area grown by one man was 25 acres.

Of the eleven varieties grown—China Patna was the most important—occupying approximately 76 per cent. of the total rice area in Tailevu and 62 per cent. in Rewa.

The varieties of secondary importance were Motka (nine per cent. and nineteen per cent.), Serea Patna (eight per cent. and ten per cent.) and Rewa Patna (four per cent.), the last two being apparently locally recognised strains of China Patna.

The remaining seven varieties together accounted for only 21·9 acres (29 growers) or approximately two per cent. of the total area. They included one small area of a British Guiana variety recently introduced by the Department of Agriculture, viz., Ramcajara.

It is significant that no areas of the dry land variety,—Sonacalif—were to be found anywhere in the area.

It appears from inquiries made that as the area is a sugar district, China Patna is favoured on account of its short season of growth as compared with Motka. Thus China Patna is usually harvested before the cane crushing season commences whereas Motka harvest is usually delayed until July—this variety taking approximately six months to mature. In this connection it may be noted that out of 558 growers in Tailevu South, only 19 were not sugar planters and one of these alone had 25 acres of Motka variety (nearly one-third of the total area devoted to that variety).

It is also considered that the yield of Motka varies greatly. This may be due to the late harvest and the increased damage caused by birds and by bad weather.

The dry land variety, Sonacalif, is not favoured owing to uneven ripening of the grain in drilled or broadcast fields. Transplanted fields do not show this and have experimentally given uniformily high yields. The grain is considered a good food and particularly profitable for sale in the form known as " Bhuja " (parched rice).

The records of yield were insufficiently complete to unable a comparison of the varieties to be made but China Patna, Serea Patna and Rewa Patna yielded up to 60 bushels per acre, while Karia Patna gave 36–40 bushels per acre. Heavy losses were experienced owing to several swarms of army worm which traversed the areas flooded during the heavy rains early in the year. In some cases also heavy losses were recorded as due to birds.

Besides giving useful information on the rice growing industry in the area, the survey indicated the potential value of rice experiments which have been carried out for some years past by theDepartment of Agriculture—particularly in connection with the selection, propagation and distribution of pure line seed of high yielding, early maturing varieties—such as appear to be most useful to the cane-farmer who is compelled to rely on one crop of rice per annum. It also indicates the desirability of encouraging the elimination of some of the many poor yielding varieties now being grown in favour of the better varieties available. It would also appear that the better yielding varieties recorded alsewhere in this issue of the *Journal*, should prove of much utility when distributions of seed are undertaken, in raising appreciably the average yields of the districts concerned without any additional labour on the part of the cultivators. It is, however, necessary that only fully proved high yielding strong-strawed strains capable of withstanding the heavy rains and winds of the district should be encouraged so that undue haste is not advisable.

Acknowledgements are due to Indian Assistant Ramnath Badh and Native Field Assistants Vairusi Loanakadavu and Sailosi Raisele who were responsible for the compilation of a large number of records in connection with the survey discussed in this paper.

GREEN MANURES.

By

MELI ROKOBICI,

Native Field Assistant.

As soon as we see that crops in our garden show sign of the poorness of the soil, we should at once think of manuring the land and planting in it cowpeas, Mauritius or rice beans. In banana plantations, citrus, coconut, &c., one may use forks in planting beans. They should be planted in rows so that it will be easier in weeding and cleaning. A cultivator can be used, if a horse is available. The distance between rows should be 3½ feet to 4 feet apart. If there is no horse available, use the hoe when the distance between rows should be 2 feet apart.

When the beans are just about to produce flowers, break the plants down by turning the harrow up-side-down and then harrow. Soon after that is done, cultivate the land so that every bit of the beans is buried in the soil. If there is no cultivator, they can be cut down with knives, and then either forks or spades can be used in digging so that every bit of the beans is buried in the soil. It is inadvisable that the beans be harrowed or weeded and then left exposed to the sun for two or three days and then tried to be buried as by that time the beans will all have dried up and as their richness is drawn away by the sun it will take much longer for the beans to rot. They should be weeded or harrowed and buried on the same day. After that, wait for three or four weeks then cultivate and harrow it again. By that time the beans will be entirely rotted and at the same time give food to the crops and also enrich the soil.

All leaves and grass weeded in the garden, should be buried.

Compost manure.—This kind of manure is the cheapest and the best to use. There are two methods of making it: (1) dig a pit 9 ft. x 18 ft. x 3 ft. deep. This should be filled up with grass, leaves and all sorts of rubbish which you think will rot. It should be mixed with soil. It has to be turned over every month so as to help it rot more quicker. (2) Dig a pit 8 ft. x 6 ft. Fill it with grass about 2 ft. to 3 ft. thick and then cover it with soil about ½ ft. to 1 ft. thick and again on top put grass to about 6 ft. thick. It should be turned over monthly until everything is turned into soil. This has to be thrown or spread all over the garden.

Farmyard manure.—If horses or cows are available, they should be kept together so that all waste from them can be collected every morning and put together in a heap. After this has been turned into soil, it can be spread all over the garden. The same thing can be done when fowls or pigs are available.

ENTOMOLOGICAL NOTES.

By
R. J. A. W. LEVER, B.Sc. (Hons.), D.I.C., A.I.C.T.A., F.L.S.

1. THE MALARIAL MOSQUITO IN THE SOUTH SEAS.

A RECENT issue of an Australian monthly publication (1) records it as a "surprising statement" that the *Anopheles* (malarial) mosquito does not exist in Fiji as was correctly mentioned by Dr. Baxter (2). Not content with this, the article goes on to say that "it has been said more than once that this insect is in Samoa."

Both these claims are difficult to account for as no serious authority has ever postulated the occurrence of *Anopheles* in Polynesia and it is, therefore, not clear how this myth has managed to persist to this day.

So far as Fiji is concerned, Paine studied all the fourteen local forms very thoroughly, collected them throughout the Group but does not so much as mention the malarial mosquito in his detailed paper (3). Taylor (4), (5) similarly does not even refer once to Fiji as a locality for *Anopheles*.

The claim for Samoa is even more difficult to maintain as Buxton (6) stated as long ago as 1927 that "south and east of the New Hebrides, *Anopheles* is absent and no malaria occurs in the Loyalty Group, New Caledonia, Fiji or any part of Polynesia. One may summarize the matter by saying that *Anopheles punctulatus* and malaria occur eastwards to 170°E. and southwards to 20°S. . . . . Outside this area, malaria is found nowhere except in Aneiytum (New Hebrides) which is only a fraction of a degree south of 20°S." Finally, Buxton's Samoan collections, made in 1924-1925, comprised only half a dozen different species of *Aedes* and *Culex* which were described by Edwards (7) who shows that as one proceeds eastwards from New Guinea, the fauna diminishes and "in Fiji *Anopheles* drops out." It would therefore be strange to have it cropping up further east in Samoa when not present in Fiji to the west.

In view of the unanimous verdict of the previous authorities it is obvious that some very special evidence will have to be brought forward in order that the absence of the malarial mosquito in Samoa and Fiji is to be regarded as a "surprising statement." Actually, its occurrence would be far more surprising than its absence as the subject has been studied so very thoroughly.

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(2) Baxter, S. R., 1939. *Agric. Journal*, Fiji. Vol. 10, No. 1, March.
(3) Paine, R. W., 1935. "Introduction to the Mosquitoes of Fiji", Suva.
(4) Taylor, F. H., 1934. "Check List of the Culicidæ of the Australian Region." University of Sydney.
(5) Taylor, F. H., 1938. *Health*, XVI, No. 8.
(6) Buxton, P. A., 1927. "Researches in Polynesia & Melanesia." Lond. Sch. of Hyg. & Trop. Medicine.
(7) Edwards, F. W., 1928. "Insects of Samoa," Pt. 6, Fasc. 2. British Museum, London.

2. THE RICE LEAF-HOPPER.

In March, 1938, reports of a serious leaf-yellowing of rice on Vanua Levu were made to the Department, but unfortunately too late for a thorough examination to try and incriminate the insect or fungus responsible.

On receipt of news this April that the trouble was beginning again, the author visited the affected areas in the Dreketi and Bua regions of the island. A small grey plant-hopper—identified in Honolulu, and subsequently in London as *Sogata furcifera* Horv.—was soon suspected, but it was noticed that the yellowing was invariably worst in the areas where the rice was

permanently flooded or had experienced heavy, or persistent, rain. This insect is a well known rice pest in India, Malaya, Java and Japan, having been first described from the last country in 1899 and, under the name *Delphax kolophon* Kirk., from Fiji in 1907 (1). It is exceptionally interesting to find that it took over thirty years to become a local pest of rice and so far has not been reported as causing damage on Viti Levu, though it occurs also on that island.

The advice given for control was draining for two to three days, or, if this is impossible, either to spray with one pound of derris in 10 gallons of water, applied by means of a rosed watering can, or to scatter on the water handfuls of rice bran or sawdust, impregnated with kerosene.

The life-history of this insect, which increases only 3 mm. in length (say one-eighth of an inch) has been studied in some detail by Miller and Pagden (2) who draw attention to its habit of moving down the rice plant when the sunlight is strong and this restricted migration accounts for its not being easily seen in the field. Further details, it is hoped, will be obtained at a future date, but this preliminary note is published in view of the particular importance of this insect's habits and distribution.

The author is indebted to Dr. E. Zimmerman, of the Bishop Museum, Honolulu, for kindly having this leaf-hopper identified. Further thanks are due to the Senior Research Officer, Division of Entomology at Canberra, the Entomologists in Queensland and Tasmania and the Directors of the Imperial Institute, London and of the Institute of Plant Diseases, Java.

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(1) Muir, F., and Giffard, W. M., 1924. Bulletin No. 15, Bulletin Experimental Station, Hawaiian Sugar Planters' Association January 16th.

(2) Miller, N. C. E., and Pagden, H. T., 1930. *Malay Agricultural Journal*, Vol. XVIII No. 5, May. XVIII, 557, 593.

3. CONTROL OF CUTWORMS ON GRASSES. XXVII, 312

In view of a lengthy outbreak of two species of cutworms on growing rice in the Wainibokasi region of the Rewa Delta and the grassland of its tributaries, it seems desirable to expand the details given in the *Agricultural Journal* for September 1938 (page 22). (Viti Levu isl.)

The larger amount of the two following poison baits was made up on the spot—except for the molasses -and left for scattering that evening, applying in small balls every 4½ feet over ½ acre:—

20 lb rice bran	5 lb. XXVII, 312.
1 lb Paris green	4 oz..
1 quart of molasses.	1 pint.
4 oranges or mandarins.	1 fruit cut up.
1 lb salt.	4 oz.

The above ingredients were well mixed and stirred up in 3 to 4 gallons of water—(*i.e.*, one kerosene tin) for the larger or in 1 gallon of water for the smaller amount.

Two circumstances made this bait easy to make up, viz., the area in question being adjacent to a rice mill enabled the bran to be obtained on the spot and being also in a cane region, molasses were cheap to buy and transport. Further, the rice land was previously under cane and the old drains helped to check fresh invasions by the olive-green cutworms which were *Spodoptera mauritia* Boisd. Attention was drawn to the necessity of keeping the drains clear of Para grass and weeds and the need for keeping stock away from the treated area to avoid arsenical poisoning.

The fact that adult toads, *Bufo marinus* (L.), were taking the caterpillars made the attack much less severe, a male examined in February in the Wainibokasi area had 18 larvæ in its stomach, though this was exceeded at Tailevu in June where one caught near the river bank was found on dissection in the field to contain 110 head-capsules of the caterpillars of *Cirphis unipuncta* Haw. in its stomach, exclusive of unrecognizable material and what was present in the intestine. Somewhat similar results have been recorded in New Guinea—where the toad was introduced in 1936 and 1937—as a check to cutworm damage on *Desmodium triflorum* (1). Great hopes are held by the present writer for the possibilities of this amphibian in Fiji and pastoralists are advised to breed-up tadpoles in tanks and semi-permanent pools or drains so that the young toads can be released in time to cope with future waves of cutworms.

In pasture land a deep furrow may be made by a mould-board plough so as to prevent invasion of fresh areas. This advice the writer realises is quite unpracticable where several hundred acres are involved, but a great deal can be done by isolation if begun early enough. The addition of kerosene to the water acts as an additional check if this can be spread on the surface of well-defined drains without injury to the plants.

Where larger areas are involved—blocks of over 300 acres are common in the Waidina/Wainimala region—the use of the poison bran when spread over even ten acres would be prohibitive and it is suggested that for these areas a kerosene or crude oil emulsion spray would be desirable. Flame-throwers are not recommended except perhaps for swarms in the very early stages.

As these sudden outbreaks invariably follow floods it would seem desirable to lay in stocks of the necessary ingredients before the usual time for the heavy rains so that the baits or sprays can be applied as soon as the young caterpillars are seen. Early ploughing of a steep-sided trench so as to isolate the caterpillars is also sound and this should be done hand in hand with cutting down of grasses on the bunds as such plants serve as additional host-plants.

As *Spodoptera* has been shown (2) to be attracted to recently sown rice in water-logged soil and also standing water kills the caterpillar, it is a sound practice to flood the fields of rice for two to three days about a fortnight after transplanting. The remark that "in South India the moths are not attracted to light" (2) does not hold good for Fiji where large numbers of both sexes are often found in the vicinity of electric light bulbs. The seasonal changes and such atmospheric conditions as cloudy nights certainly seem to determine outbreaks more than food-supply, and this applies in Fiji as much as in India.

REFERENCES.

(1) *New Guinea Agric. Gazette* 1939, Vol. 5, No. 2, June, page 34.
(2) Anantanaryanan, K. P. & Ayyar, J. V. R. 1937. *Agriculture and Livestock in India.* Vol. VIII, Pt. 6. Novbr.

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4. RICE INSECTS.

Fiji is fortunate in that insect pests of rice usually cause only very slight damage which is in marked contrast to the Far East where insects take a very heavy toll of this crop, especially stem-borers which are unrecorded from Fiji.

The writer is unaware of any article dealing at length with local rice pests and though the following notes will doubtless require subsequent amending, if only by additional records, yet it seems desirable to have them published now.

The most serious damage is done periodically by two army worms or cut-worms, *Spodoptera mauritia* Boisd. and *Cirphis unipuncta* How., which as caterpillars bite off the heads of young flowers (potential grain) or eat the leaves. As the control of these insects has been dealt with both in an earlier issue and elsewhere in this present *Journal*, it will not be given again here.

In the Dreketi and Bua areas of Vanua Levu Island it was found that leaves of the young rice plants had an orange-red appearance due to the attacks of a small leaf-hopper *Sogata furcifera* Horv. This condition disappears very rapidly indeed when the water is drained from the rice-beds and undoubtedly standing water is a primary cause of the condition. The sudden rise to economic status of this small insect, known from Fiji for over 30 years, is dealt with more fully in a separate note where control measures are also given (Number 2).

Another bug, measuring 15 mm., is *Leptocorisa varicornis* F. very closely allied to the Asiatic L. *acuta* Thunb. which is a severe pest in the Malay States and East Indies. The local species is found on Para and other grasses but only rarely does any real damage to rice by sucking the sap from the ears of the grain in the, "milk ripe" stage. The control practised in the Far East is to sweep up the bugs in bags soaked in crude oil, in nets or by dragging boards on ropes made sticky with tanglefoot or some other gummy substance (1).

Beetles in this Colony appear only to attack stored grain (padi), which is of interest as in New Britain, Territory of New Guinea, the ladybird *Coccinella 8-maculata* F. feeds on the leaves (2). The larva of this orange and black beetle in Fiji is often found eating the green fly *Aphis maidis* Fitch on maize and was also taken in close association with *Sogata* on rice. No local records or observation lead one to think the adult has so far attacked rice leaves in Fiji.

Beetles found on the stored rice include *Oryzæphilus surinamensis* L. (also on coconut meal and in peach stones), the flour beetles *Tribolium castaneum* Hbst. and *T. ferrugineum* F. and the small weevil *Diocalandra oryzæ* L. (also in breakfast cereals and stored maize cobs). In addition, the copra "bug," *Necrobia rufipes* de Geer and *Alphitobius lævigatus* F. have been found regularly in rice bran purchased for horse fodder from a Suva merchant. The presence of lower grade broken rice and rice bran has been shown in Madras (3) to encourage this weevil.

Control of stored product insects hinges on cleanliness in the sheds or go-downs, thorough drying of the grain, a minimum storage time and perhaps fumigation with the deadly prussic acid gas (½ lb of sodium cyanide per 1,000 cubic feet) or preferably with carbon bisulphide (5 lb or 3 pints for the same space). Instead of fumigants, one may store immediately after threshing by covering the grain in the bins with half an inch of hydrate lime or dry sand or by adding two ounces of copper carbonate dust to each bushel. Dry grain is relatively unattractive to most insects so that storing it dry in clean sheds will ensure its being attacked but lightly.

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(1) Jack, H. W., 1923. "Rice in Malaya." Bull. No. 35, Dept. of Agriculture, F.M.S. & S.S.

(2) Froggatt, J. L., 1939. *New Guinea Agricultural Gazette*, Vol. 5, No. 1, March.

(3) Ramiah, K., 1937. "Rice in Madras." Government Press, Madras. 2 rupees.

5. NOTES ON WHITE ANTS.

The last (June) issue of the *Journal* mentioned the occurrence in Fiji of the Central American termite, *Cryptotermes brevis* Walk. This identification was mentioned as having been made by the Imperial Institute of Entomology, but a world authority on Australasian white ants—Mr. G. F. Hill of the Council for Scientific and Industrial Research—has recently doubted this determination, and suggests that both records (1932 and 1937) were probably *C. buxtoni* Hill, mentioned previously (1) as having been found in 1932 in Fiji and in furniture in Samoa. Since then a strong colony of this termite was taken by the writer in a piece of 3-ply wood in Suva and this has proved to be the same material in which a colony was taken in 1933, also in Suva.

Complete proof of the local occurrence of *C. brevis* depends on members of the soldier caste being collected, and until that happens, it is preferable to doubt whether this tropical American pest occurs in Fiji.

(1) Lever, R. J. A. W., 1939 *Agricultural Journal*, Fiji, Vol. 10, No. 1, March.

CHEMICAL NOTES.

SUMMARIES OF RECENT INVESTIGATIONS CARRIED OUT BY THE CHEMICAL STAFF.

By

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Derris.—Species of *derris* grow well in this country and the Department of Agriculture has given a considerable amount of attention to what could well become an important subsidiary crop.

Up to the present, imported planting material has not yielded under our climatic and soil conditions the ether extract and rotenone contents obtained with the same material in Malaya. In this laboratory rotenone contents of 1·5 per cent. have been determined on samples from planting material giving over 5 per cent (the commercial requirement) in Malaya. These values were confirmed by the Chemists of the Imperial Institute. Planting material obtained from Singapore and grown in Fiji gave on a recent analysis 2·39 per cent. rotenone and 13·25 per cent. ether extract. This is a slight improvement over former figures, but the rotenone contents will have to be improved if we wish to compete with other Colonies. This matter is receiving attention on the experimental stations.

Fiji ginger.—Three samples of Fiji-grown ginger were submitted by the Director of Agriculture in connection with a trial parcel forwarded to England. The following values were obtained:—

	Sample 1. per cent.	Sample 2. per cent.	Sample 3. per cent.
Moisture content	13·63	12·59	12·52
Alcohol solubles	3·57	3·60	4·50
Water solubles	12·50	13·40	11·62
Ash	4·55	4·88	5·17
Water Soluble ash	3·18	3·58	3·99

Samples 1 and 2, are slightly low in alcohol soluble constituents and sample 3 just meets the requirements of the British Pharmacopœia. This matter can be improved by selection.

In connection with this work a sample of preserved ginger was prepared in the laboratory and will be forwarded to England for valuation in connection with the confectionary trade which has suffered from the lack or normal supplies from China.

Fiji Kauri Gum (*Agathis vitiensis*).—Three samples of several pounds of kauri gum were submitted by the Conservator of Forests. These were labelled (1) crude (2) selected, and (3) milled and washed. It was not found possible to grade the matrial by colour or apparent purity as far as the "crude" sample was concerned. The colour of the "selected" material ranged from yellowish white to dark brown but an improvement on this grade could be effected by the removal of approximately 20 per cent. of the darker coloured constituents. Grading by hand-picking was not possible with the "milled and washed." Impurities in the gum were determined by solution in 95 per cent alcohol, filtration, washing and weighing the impurities. The result obtained were as follows:—

(1) Crude . . . . . 1·27 per cent impurities.
(2) Selected . . . . . 0·80 ,,
(3) Milled and washed . . . . 2·34 ,,

It would appear that the local term "selected" produces the best quality on the score of impurities but that the "milled and washed" should be labelled "crude." In any case there is not much difference between the local grades and the prices obtained to-day would not warrant grading costs.

Fiji Kauri gum appears to differ somewhat in chemical constants from the related New Zealand species. The following acid, saponification and ester values are recorded:—

	Acid value.	Saponific. value.	Ester value.
Fiji crude	123·2	176·9	53·7
Fiji selected	120·3	169·5	49·2
Fiji washed	125·6	172·0	46·3
New Zealand crude	63 to 64	....	...
New Zealand selected	81	95 to 109	...

Camphor.—In the 1909 plan of the Nasinu Experimental Station four camphor trees are recorded and recently it was decided to determine the camphor contents of the leaves and twigs of the two remaining trees identified by Mr. B. E. V. Parham of this Department as *Cinammonum camphora* L.—the true camphor. The oil of camphor was extracted by steam distillation of the leaves, petioles, twigs and smaller branches. The oil yields and camphor contents were low in comparison with the Japanese material. The oil content of the green leaves amounted to about 0·1 per cent. and the camphor content to 0·05 per cent., as compared with average Japanese material from Formosa of 0·8 per cent. and 0·2 to 0·3 per cent. respectively.

Glycerine.—A local firm has been experimenting with the concentration of soap lyes, the watery solution of glycerine, salt, &c., left as a waste product in the manufacture of soap. The concentrate analysed in the laboratory contained 14·95 per cent. of ash and 44·99 per cent. of glycerol. This represents a very fine effort in direct concentration but in order to produce a marketable product vacuum concentration methods will have to be adopted.

Fiji stick tobacco.—In collaboration with the Produce Section of the Division of Agriculture, attempts have been made to produce a stick tobacco for export purposes similar to that produced by competitors in this field.

Fair quality stick containing liquorice, olive oil and other essential constituents has been manufactured recently, nevertheless the limiting factor to a good quality article is the nature of the tobacco submitted for manufacture. It has been decided to give greater attention to curing, fermenting and ageing of the leaf by the Agricultural Division as a preliminary to further manufacturing operations.

Grading of copra.—The Chemical Division in pursuance of its past programme directed to the improvement of Fiji copra has given attention to grading. Several firms have kindly co-operated in this work and submit monthly samples of copra for assessment under the grading scheme devised by the Director of Agriculture. Samples are graded according to this scheme and moisture determinations are made. Of the thirty grading tests performed to date on samples from all parts of the Colony, nine parcels were classed "first grade," ten "second grade" and eleven "ungraded." Eight samples of copra from Samoa, Rabaul, Mozambique, Ceylon, Dutch East Indies and Straits were obtained by a local firm from English sources and handed to the laboratory for grading. The materials submitted secured six "first grade" and two "second grade." This work is proceeding and will be dealt with in more detail in a further communication.

Soil surveys.—Trained staff limitations and multiplicity of general chemical duties make it difficult to proceed rapidly with this work. Nevertheless, important studies have been made in Tailevu, Navua and the Sigatoka areas and a special survey of Sigatoks Station has been performed. The soil work performed in the field clearly indicates that one of the most important factors limiting soil productivity in Fiji is and has been extensive erosion. In many locations soils which must have been several feet in thickness have had the "A" horizon completely eroded. The infertility of much of the "talasiga" country is due to this cause. From evidence secured in soil survey studies, erosion to-day is not so extensive as in the past. This is due to the fact that many acres of good land were wasted in the past by the Native practice of shifting cultivation in steep locations and burning off. Such practices in localities of 100 inches of rain per annum do not allow of soil retention. A lot of this wasted land although unfit to carry agricultural crops is now covered and should remain out of cultivation and free from over-stocking. Marginal lands of this nature if open to cultivation would last for a few years and then become an inert true "talasiga." The Native description of such country as "one year," "two year" country, &c., can be closely correlated with the amount of erosion they have suffered in the past.

Laboratory studies on soils.—Soil studies in the past have been directed to the determination by emperical methods of total and available K_2O and P_2O_5, nitrogen, humus and mechanical composition. A condierable amount of information of this nature has been compiled for the main soil types of the Colony. Present research is being directed to the more fundamental physico-chemical properties and in this connection, silica to alumina ratios, base exchange, base saturation, percentage of exchangable hydrogen are being determined by approved techniques on selected soils. The degree of lateritisation of our soils is indicated by silica to alumina ratios of 1·01 to 1·85.

Food stuffs.—Under instructions from the Director of Agriculture, and in collaboration with Mr. A. B. Ackland, the Produce Inspector, the laboratory has been engaged upon important duties in connection with the preservation of foodstuffs and the milling of fine cereals and other wholesome products from local and imported grains.

Under instructions from the Director of Agriculture, and in collaboration with Mr. A. B. Ackland, the Produce Inspector, the laboratory has been engaged upon important duties in connection with the preservation of foodstuffs and the milling of fine cereals and other wholesome products from local and imported grains.

In the event of Fiji being isolated for a period during hostilities, the preservation and milling of staple foodstuffs becomes a problem of paramount importance. It is well known that grain would keep better under Fiji conditions than imported milled and refined products, and with the absence of flour-milling machines in the Colony, attention has been directed with success to simple milling procedures.

It has been found that a good product resembling sharps can be produced by simple pounding of wheat in an iron mortar and separating a large proportion of the bran by sieving through a 1 mm. sieve.

Better results were obtained by grinding the material in a small mill. In one experiment, five pounds of wheat were finely ground in a short period, and gave 1 lb 15 oz. bran and wholemeal, and 3 lb 1 oz. of sharps and flour. This latter material was further separated by 0·4 mm. sieve into 53 per cent. flour and 47 per cent. bran and sharps. The separated materials were analysed, and the following results were obtained:—

Sample.	Moisture	Protein.	Oil.	Sol. Carb.	Fibre.	Ash.	Fuel value.
							C lb
A	13·66	12·27	3·65	68·44	0·97	1·01	1,620
B	13·72	12·91	1·83	67·59	2·45	1·50	1,553
C	13·35	10·98	2·57	72·05	0·23	0·82	1,609
D	11·79	15·81	2·15	58·17	10·01	2·07	1,424

A = The whole grain ground to pass through a 1 mm. sieve = (whole meal).
B = That portion of the material passing through 1 mm. but retained on 0·4 mm. sieve = (mostly bran).
C = Material passing through 0·4 mm. sieve after removal of B = (fine sharps).
D = Canadian wheat-feed for stock.

The analyses indicate that samples "A" and " C " are suitable for bread-making, a better quality of loaf being obtained by the use of " C."

Bread-making trials in collaboration with the Superintendent of Prisons, are in progress with the products obtained during the investigation, and indicate that excellent whole meal bread can be made.

The assistance of Mr. Bryant of Nadi, who milled some of the wheat through his machinery, is gratefully acknowledged by the Department.

REVIEWS.

1. MEASURES AGAINST PESTS OF STORED GRAIN.

An excellent little pamphlet* published last March by a Committee for the Department of Scientific and Industrial Research, and published for threepence, deals with the important problem of how to combat insect damage to stored grain and feeding stuffs.

Although when serious, such infestation requires the use of specialised methods, in ordinary storage of grain in farms and warehouses much damage may be avoided by reasonable attention to some simple precautions.

The most important pest is the grain-weevil, which has a very close ally in Fiji in the rice-weevil, *Diocalandra oryzæ* L. which also occurs less commonly in England and is able to fly.

Associated more with flour than grain are the flour beetles, of which *Tribolium castaneum* Hbst. is common in packets of breakfast cereals purchased in Suva. Another pest of rice bran and coconut meal is the saw-toothed grain beetle, *Oryzæphilus surinamensis* L. Turning from beetles to moths, one finds the fig moth, *Ephestia cautella* Wlk. as a pest of warehouses in the United Kingdom and local records prove it to breed in linseed, raisins, copra and old bananas.

The practical measures for general use are so succinctly arranged, that it is best to quote the Committee's recommendations *verbatim* :—

" Insects and mites increase in numbers only when they have an undisturbed food supply and breeding ground. Obviously, therefore, neglected heaps of old grain or feeds, sweepings, old sacks, and long-accumulated debris in corners and in cracks between floorboards form ideal breeding ground for them; and the first step in the war against these pests is to see that no such breeding grounds are allowed to remain.

" In the course of a survey of stores in different parts of the country it has been found, repeatedly, that heavy infestation by insects and mites arises under the conditions outlined above, and, in contrast, where strict attention has been paid to the cleanliness of meal stores and barns very few insects are found.

" It is thus possible, by the use of ordinary common-sense methods based on a knowledge of their habits, to reduce insect infestation very considerably, and if action is timely even to prevent it. This applies not only to farms, but also to mills and warehouses.

" The following precautions should be observed:

" *Ventilation.*—Storage should be clean, well ventilated, watertight and not artificially heated.

" *Spacing.*—A space, preferably of about two feet, should be left between different consignments.

" *Stacking.*—Sacks should not be stacked against the walls, but a space of at least 18 inches from the walls should be left wherever possible.

" *Cleanliness.*—Sweeping should be thorough and regular, at least weekly, particular attention being paid to corners and confined spaces, as, for instance, under machinery. Walls should not be neglected.

" *Destruction of Sweepings.*—Sweepings must be removed at once. They should on no account be bagged and stored, or mixed with clean material.

* " Pests of Grain." His Majesty's Stationery Office, London, March, 1939. (Department of Scientific and Industrial Research.) 3d.

" *Rotation.*—Where large quantities of material or of empty sacks are being handled, a system of rotation should be adopted in order to prevent anything remaining undisturbed for an undue period.

" *Isolation of Infested Goods.*—Infested material should never be stored near clean goods, but should, wherever possible, be isolated. All bins and other receptacles should be completely emptied of old grain or feed and thoroughly cleaned before new stores are placed in them. Certain goods, notably rice meal and dari* seed, should always be regarded with suspicion.

"*Examination for Insects.*—The following information may help in the process of examining goods for the presence of insects. Insects are commonly found in the following places:—

(*a*) between adjacent sacks;
(*b*) between sacks and walls, where these are allowed to touch;
(*c*) in the ears and folds at the top of sacks;
(*d*) at the highest or the darkest points in bulked material;
(*e*) on the floor, and more particularly on the walls, near infested goods."

" *Purchase of grain.*—Great care should be exercised by farmers in the purchase of grain or feeds, and all samples showing the presence of insects should be avoided. Infested material may be cheap, but its cheapness will be dearly bought if the farmer's own grain is subsequently rejected or reduced in price by the merchant on account of weevils."

Since the above review was written, war has broken out in Europe and the necessity for such an isolated Colony as Fiji to reduce to the minimum the damage to stored grain of all kinds has been become worthy of serious attention. —R.J.A.W.L.

* Dari = Sorghum, millet or guinea corn.—Editor, A.J.

2. THE *EPHESTIA* PEST OF STORED COCOA AND COPRA.

The caterpillar of the grey-brown fig moth *Ephestia cautella* Wlk. was mentioned in the issue of the *Journal* for last September (Vol. 9, No. 3) and its control by cleanliness in and fumigation of warehouses was recommended.

Besides copra, this insect is a severe pest of stored cocoa beans, dried vegetables, tobacco and seeds so that an article* on its habits and control in Ceylon is of interest. Although a different product is concerned, it is nevertheless damaged by the identical insect so that the following points are worthy of local aplication. Dr. Fernando states that as warehouse infestation is intensified by long storage, transport should be speeded up all the way from the estate to the boat. The practice of storage till the advent of satisfactory market conditions should be discouraged. Too much emphasis cannot be placed on the importance of scrupulous cleanliness, satisfactory illumination (the moth likes dark, still air) and ventilation of warehouses whose floors should be frequently swept and walls and ceilings frequently whitewashed. The reviewer saw an instance of a Suva firm wisely taking advantage of its copra-shed being empty by having it fumigated and this, with cleanliness, is certainly the best method for reducing the depredations of the caterpillars, and this applies also to the copra " bug " *Necrobia* and other beetle pests of stored copra. —R.J.A.W.L.

**Tropical Agriculturist*, XCVII. No. 3, March, 1939.

3. CONTROL OF FRUIT FLIES IN CEYLON.

The *Agricultural Journal* for June, 1938 (Vol. 9, No. 2, p. 31), gave an extract about the fruit-flies on citrus in the Jordan Valley and the necessity for picking up and destroying all ripe fruit. The following extract* by Dr. J. C. Hutson in Ceylon may therefore, be of interest as showing the need for similar methods in an island Colony more comparable with Fiji than Palestine:—

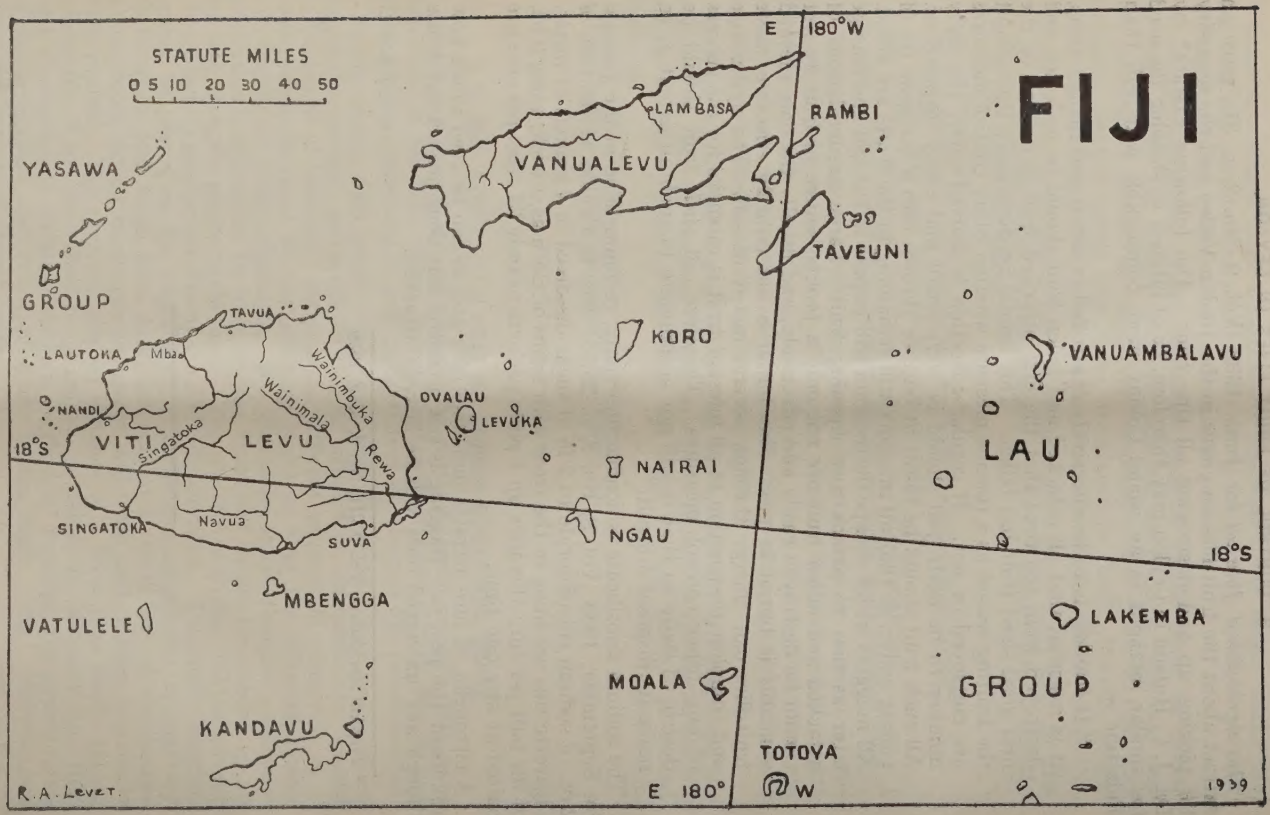
> " If fruit-fly is to be effectively controlled in citrus and mango areas, it is essential that all attacked and fallen fruit should be collected and destroyed from the time that the first attacked fruit is noticed or the first good-sized fruit has fallen. This should be done daily throughout the fruiting season as a routine measure whether other control measures are employed or not. If regular collection is started early, the daily number to be destroyed should be very small and easily disposed of. All such fruit should be burnt at once or thrown into a kerosene tin of boiling water, so that all maggots still remaining in the fruits are killed. All maggots which escape destruction will pupate in the soil and emerge later as flies to attack any ripening fruit. Large accumulations of attacked and fallen fruit are not only a prolific source of fruit-fly but cannot be destroyed easily and effectively, and usually the only method available is burial in pits. But burial is not entirely effective, since fruit-flies can emerge through several inches of soil. The systematic and complete destruction of all infested fruit is essential for the success of any other control measures. Therefore, all such fruit should be destroyed daily so that it will not accumulate to such an extent as to make its disposal difficult."

The sodium fluosilicate (silicofluoride) spray, recommended in the *Journal* for September, 1938 (Vol. 9, No. 3, p. 20), is used in Ceylon at the rate of 2 oz. of sodium silicofluoride to 2 lb of sugar dissolved in 4 gallons of water. Cigarette tins are hung in the trees with strips of cloth as a wick, using 3 oz. of the bait per tin: this uses up 4 pints per acre as only 24 trees per acre are baited at any one time.

A citronella oil lure attracts male flies only and so can be used to see how abundant the pest is. Bagging is not a control but does protect the fruits though any unbagged ones will be heavily attacked.

—R.J.A.W.L.

* *Tropical Agriculture*, Vol. XCII, No. 5, May, 1939.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